cœnenchyma respectively (figs. 2–5); but when magnified, as in fig. 6, on a much lower scale, being smaller, it might, without this explanation, lead to the idea that the stellate venation was much smaller than the general cœnenchymal structure, while it is greatly the reverse.

Fig. 7. *Favosites gothlandicus.* *a*, portion of surface, to show the hexagonal form of the cells; *b*, portion of vertical section, to show the *vertical* septa or walls of the cylinders traversed by the *tabulæ*.

Fig. 8. *Labechia conferta.* *a*, horizontal section, to show the arrangement of the rods or pillars, and the lines (*tabulæ*) traversing their interspaces—also that they were hollow, as indicated by the white centre now filled with transparent calcite; *b*, vertical section, to show the same, but with closure of the pointed free extremities.

N.B. These figures (viz. 7 and 8) are all magnified upon the same scale, viz. two diameters, and are slightly diagrammatic, to show how the rods and tabulæ of *Labechia*, replacing the cylinders and tabulæ of *Favosites*, present an analogous structure to the rectilinear cœnenchyma of *Stromatopora* (figs. 2 and 3).

XXX.—*Descriptions of Palæozoic Corals from Northern Queensland, with Observations on the Genus* Stenopora.

By H. A. Nicholson, M.D., D.Sc., F.G.S., &c., Professor of Natural History in the University of St. Andrews, and R. Etheridge, Jun., F.G.S., of the British Museum.

[Plate XIV.]

[Continued from p. 226.]

Genus Stenopora, Lonsdale, 1844.

Stenopora, Lonsdale, Darwin's Geol. Obs. Volc. Islands, 1844, p. 161 (note).

Stenopora, Lonsdale, Strzelecki's Phys. Descr. New South Wales &c., 1845, p. 262.

Tubulicldia, Lonsdale, Bull. Soc. Géol. de France, 1844, 2nd ser. i. p. 497.

Tubulicldia, Lonsdale, Murchison's Geol. Russia, 1845, vol. i. pp. 221 and 631 (note).

Gen. char. Corallum ramose or sublobate, rarely massive, rooted below, and composed of tubular corallites, which are nearly vertical in the centre of the branches, and radiate outwards, from an imaginary axis, to open on all points of the free surface. Corallites polygonal, thin-walled, and more or less completely in contact in the centre of the branches; but in the outer curved portion of their course more or less cylindrical, and annulated by periodical ring-shaped thickenings, which are placed at corresponding levels in contiguous tubes,

in such a manner as to leave vacant spaces between the intervening unthickened portions. Visceral chamber in the outer portion of the tubes alternately contracted and dilated in correspondence with the periodic thickening of the walls just spoken of, but open and subpolygonal in the axial portion of the corallum. Septa obsolete. Tabulæ remote, usually placed at corresponding levels in contiguous tubes. Mural pores of small size, not numerous, and irregularly distributed.

History. The genus *Stenopora* was proposed and partially described by the late Mr. Lonsdale in an appendix, entitled "Description of six Species of Corals from the Palæozoic Formation of Van Diemen's Land," to Dr. C. Darwin's work 'Geological Observations on the Volcanic Islands' *. Of the few characters assigned to it, the only one which can be at all seized upon as of generic value is the so-called periodical constriction of the tubes. Two species were described in detail, *Stenopora tasmaniensis* and *S. ovata*. From the remarks made by Mr. Lonsdale on the former we gather that the branches sometimes become hollow, and that the tubes in the body of each branch are angular, but after deflection towards the surface they become oval. No tabulæ were observed. Some peculiar changes in the surface of the colony were observed by Mr. Lonsdale: for instance, where the mouths of contiguous corallites are not in contact they were seen to be separated by foraminated grooves, the latter becoming, as growth progressed, gradually filled up; the walls then thickened, and a row of tubercles were developed along the crests so formed. The mouth afterwards became closed by a lamina projecting from the inner wall.

In Count P. de Strzelecki's work 'Physical Description of New South Wales, &c.' †, Mr. Lonsdale further described *Stenopora*, gave additional notes on the two species already mentioned, and added two others, *S. informis* and *S. crinita*, both massive forms, the two previously described species being ramose. In the generic description now given the contraction of the corallites "at irregular distances, but in planes parallel to the surface of the specimen," is mentioned, and also the existence of additional interpolated tubes. We may here remark that in this final definition of *Stenopora* by Lonsdale there is no character which would now be regarded as of generic importance.

The structure of *Stenopora ovata* is described at greater length than in the previous notice of this species. In the centre of the branches the tubes are in contact and polygonal,

* London, 1844, pp. 161–169. † London, 1845, pp. 262–266.

and the tubular "constrictions" are very numerous and strongly marked; but no satisfactory evidence was forthcoming of the ultimate closing of the tube-mouth in *S. ovata*, as described in *S. tasmaniensis*.

In the form described under the name of *Stenopora crinita*, Mr. Lonsdale observed that the additional or interpolated tubes sometimes sprang "from the lines of contraction, but sometimes commenced in the spaces between them."

In a table of fossils attached to a paper by Murchison and De Verneuil on the Permian System of Russia*, the name *Tubuliclidia* (Lonsdale) is used instead of *Stenopora*, and two additional species are there mentioned, *S. spinigera* and *S. crassa*.

In Murchison's 'Geology of Russia' the name *Tubuliclidia* is retained† in a similar table of fossils; but in an appendix ‡ to this work the name *Stenopora* is again made use of, and *Tubuliclidia* relegated to the synonymic list. The two species previously mentioned are here described and figured; and although Lonsdale says nothing about the presence of tabulæ, if we mistake not, they are distinctly figured in one of the illustrations of *S. crassa* §.

In 1848 Prof. J. D. Dana‖ pointed out that the diagnosis of *Stenopora* by Lonsdale was insufficient, and redefined it as follows:—"Internal structure of corallum fine, prismatic; cells of surface minute, subangular, contiguous; zoophytes glomerate or ramose; surface often small-verrucose." This definition adds nothing to our knowledge of the genus as worked out by Lonsdale.

In 1849 the same author referred¶ all Lonsdale's species of *Stenopora* to the genus *Chætetes*; but, at the same time, he did not fail to notice the peculiar tube-accretions, termed by Lonsdale "constrictions;" and he likewise confirmed the latter's observation on the occasionally hollow nature of the branches in the ramose species. Dana, in addition, described a new species as *Chætetes gracilis***, which appears to be congeneric with *S. tasmaniensis* and *S. ovata*.

Messrs. Milne-Edwards and Haime, in their memoir on the Perforate and Tabulate Zoantharia††, define *Stenopora* as a *Chætetes* with small styliform processes at the angles of the calices, and give as their type *S. spinigera*, Lonsdale. This definition was repeated in their Introduction to their

* Bull. Soc. Géol. de France, 1844, ser. 2, i. p. 475.
† Vol. i. 1845, p. 221. ‡ P. 631. § Tab. A. fig. 12, *a*.
‖ Wilkes's U.S. Explor. Exped. Zoophytes, p. 537.
¶ Ibid. Geology, pp. 711, 712. ** P. 712, t. 10. fig. 15.
†† Comptes Rendus Hebd. 1849, xxix. p. 261.

'Monograph of the British Fossil Corals' *; whilst in their more extended work 'Polypiers Fossiles &c.' they placed the whole of the Australian species described by Lonsdale doubtfully in the genus *Chætetes* †, and noticed the presence of tabulæ in *S. crinita*.

It has already been pointed out by one of us ‡ that "they (*i. e.* Edwards and Haime) thus do not notice the characters relied upon by Lonsdale and M'Coy as separating *Stenopora* and *Chætetes*, whilst they introduce a feature not mentioned by either of these observers. In other words, they break up Lonsdale's genus into two portions, one of which, typified by *Stenopora spinigera*, Lonsd., they retain under *Stenopora*; whilst the other, comprising all the (so called) species enumerated by M'Coy, King, Geinitz, and Howse, they place under *Chætetes* and *Favosites*."

In 1851 Prof. M'Coy gave a diagnosis of *Stenopora* derived from the study of so-called British species. He described the presence of lateral gemmation, the absence of connecting tubuli or foramina in the tubes, and the presence of "imperfect diaphragms perforated in the middle" §.

This would have been a real advance in our knowledge of *Stenopora*, because Lonsdale said no trace of transverse diaphragms had been noticed ‖, were there any evidence to show that M'Coy's definition was based upon corals really belonging to this genus ¶, or possessing a structure at all similar to that exhibited by either of the typical forms, *S. tasmaniensis* or *S. ovata*. M'Coy's "*Stenopora fibrosa*, Goldf.," which is the first species described after his definition, is a Silurian form, and is almost certainly a *Monticulipora*. Any appearance of "perforated diaphragms" in *Stenopora* can only be due to the periodic contractions of the visceral chamber by the annular thickenings of the walls of the corallites, the true tabulæ being thin, horizontal, and complete, as we shall show hereafter.

* 1850, p. lxi. † 1851, pp. 273, 274.
‡ Quart. Journ. Geol. Soc. xxx. p. 499.
§ Brit. Pal. Foss. fasc. i. p. 24.
‖ Darwin's Geol. Observations, p. 162.
¶ We have carefully examined specimens and thin sections of *Monticulipora* (*Chætetes*) *tumida*, Phill., which M'Coy described as a *Stenopora*; and we find this form to very closely approach the type species of *Stenopora* in internal structure, with which, in fact, it agrees in most features of importance. The thickening of the tubes towards their mouths, however, appears to be not so distinctly a periodical and annular thickening, and mural pores have not been yet detected, while several Silurian *Monticuliporæ* exhibit similar features in a less marked form. Under these circumstances, therefore, we have not felt ourselves justified in actually removing *Monticulipora* (*Chætetes*) *tumida*, Phill., to *Stenopora*.

Fromentel, in his 'Introduction à l'étude des Polypiers Fossiles' *, follows Edwards and Haime in referring the *Stenoporæ* to *Chætetes*, with a note of interrogation; indeed this reference is adopted by Milne-Edwards even in his most extended and latest work on this subject, 'Histoire naturelle des Coralliaires' †.

Prof. de Koninck has, to us, made a most inexplicable reference ‡ in placing *S. tasmaniensis* and *S. ovata* as synonyms of *Monticulipora tumida*, Phill. (*Chætetes tumidus* auctt.). They have no specific connection with this characteristic European Carboniferous species.

In the Cambridge 'Catalogue of Cambrian and Silurian Fossils' §, the late Mr. J. W. Salter adopted *Stenopora* nearly in the same sense in which it was employed by Prof. M'Coy.

In 1874 a paper by one of the present writers ("Descriptions of Species of *Chætetes* from the Lower Silurian Rocks of North America)" was published ‖, in which the relations of *Stenopora* to other genera were touched on. One very important point is here brought forward, viz. that in all the American Devonian and Silurian species of *Monticulipora* examined by the author the outer walls of the corallites were exposed by fracture, as in *Stenopora*, although in every other respect the characters were those usually ascribed to *Chætetes*. The confusion which has arisen by the indiscriminate use of the terms *Favosites*, *Chætetes*, *Monticulipora*, and *Stenopora* by various authors is again commented on by the same writer in his 'Report upon the Palæontology of the Province of Ontario' ¶. The difficulty formerly experienced in separating *Chætetes* from *Stenopora* is here alluded to; and the author considers that the forms referred to the latter by palæontologists who have written since Lonsdale cannot be separated from *Chætetes*.

In a paper "On the Affinities of the Anthozoa Tabulata" **, Dr. G. Lindström has proposed the elimination of *Stenopora* from amongst the Tabulate corals, and the placing of it with the Polyzoa.

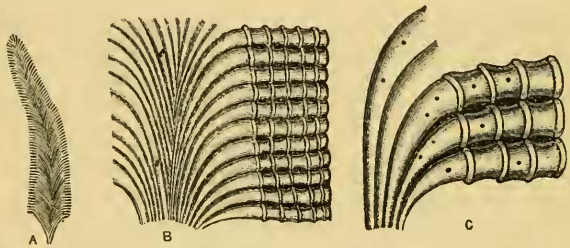
The last reference we have to make in the history of this interesting genus is an important one. In his recent work, "Recherches sur les Fossiles paléozoïques de la Nouvelle-

* Paris, 1858–61, pp. 274, 275. † Vol. iii. 1860, p. 272.
‡ Nouvelle Recherches sur les Animaux foss. &c. pt. i. 1872, p. 143.
§ Cambridge, 1873, pp. 29, 108.
‖ Quart. Journ. Geol. Soc. 1874. xxx. pp. 499–515.
¶ Toronto, 1874, pt. i. p. 60, 1875, pt. 2, p. 29.
** Ann. & Mag. Nat. Hist. 1876, xviii. p. 9.

Galles du Sud,' Prof. L. G. de Koninck has shown the existence in *Stenopora ovata* of mural pores or perforations *, and, in consequence, has referred it to the genus *Favosites*. The pores in question are described as irregular in disposition, some on the faces of the walls themselves, others on the angles of the corallites. The presence of tabulæ, first figured by Lonsdale in *Stenopora*, is recorded in this species.

Obs. Taking *S. ovata*, Lonsd., as the foundation of the following remarks, the corallum in *Stenopora* is usually more or less branched; but the branches may be so thick, or may so extensively coalesce, that its general form becomes that of a lobate mass. The corallites (fig. 1, A) radiate in all direc-

Fig. 1.



A. Portion of a branch of *Stenopora Jackii*, Nich. & Eth., Jun., split open, of the natural size. B. Portion of the same, enlarged, showing the annulation of the tubes in their outer portions. C. A few of the tubes of the same, still further enlarged, showing the mural pores. Permo-Carboniferous, Queensland.

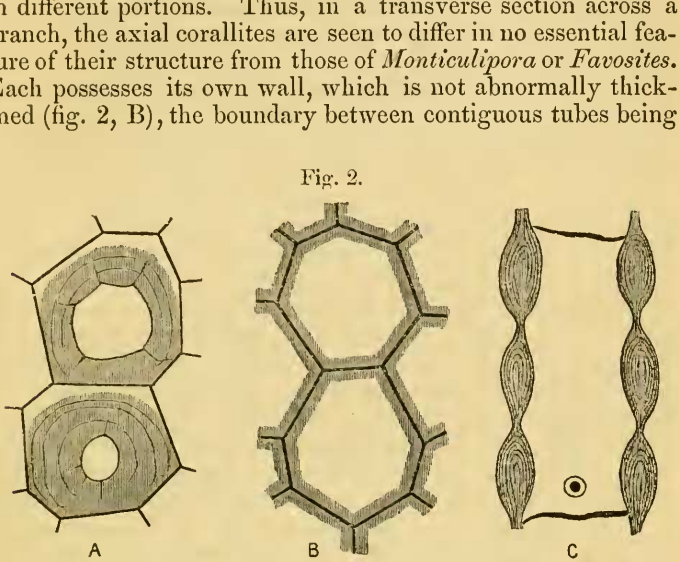
tions from an imaginary axis, and present very different appearances in the central and circumferential portions of the corallum respectively. In the axial portion of the branches the tubes are nearly vertical, are essentially polygonal or prismatic in shape, have thin walls, and are nearly or quite in contact with one another throughout. As they pass upwards the tubes gradually diverge, coming, at last, to be nearly horizontal, and preserving this direction for a considerable distance, till they at last open upon the surface. There is thus an exterior zone of the corallum, in which the corallites are nearly transverse to the axis of the branches; and in this region (fig. 1, B) they have a generally cylindrical appearance, owing to the fact that their walls are thickened at very short intervals by annular accretions of growth, the portions of the tube between them retaining their normal diameter. As these thickened portions are placed at corre-

* Bruxelles, 1877, pt. 3, pp. 156, 157.

sponding levels in all the corallites, it follows that the tubes are in actual contact with one another at these points only, and that they are separated by ring-like spaces corresponding with all the unthickened segments of the tubes.

Thin sections of the corallum show different appearances in different portions. Thus, in a transverse section across a branch, the axial corallites are seen to differ in no essential feature of their structure from those of *Monticulipora* or *Favosites*. Each possesses its own wall, which is not abnormally thickened (fig. 2, B), the boundary between contiguous tubes being

Fig. 2.



A. Two tubes of *Stenopora ovata*, Lonsd., cut transversely across their thickened portions, and showing the contraction of the visceral chamber by an annular deposit of sclerenchyma, which is not in contact with the wall on one side. B. Two tubes of the same from the centre of a branch, cut across, and showing the thin walls and polygonal form. C. Portion of a tube of the same cut longitudinally, showing the thickening of the wall, the tabulæ, and one of the mural pores. Enlarged twenty-five times. Permo-Carboniferous, Queensland.

clearly indicated by a distinct dark line. The tubes in this portion of the corallum are also regularly polygonal, and are certainly, as a rule, in close contact. On the other hand, in sections tangential to the branch and taken a little below the surface, the tubes are cut across in their outer portions, where they are periodically thickened. The tubes still appear to be polygonal and in contact, each being bounded externally by a well-marked dark line; but the appearances presented by the area within this boundary-line are very puzzling, apparently varying according as the section traverses the tubes at the level of their thickened portions or at that of the unthick-

ened intervals between the latter. In the former case the visceral chamber (fig. 2, A) is seen to be greatly contracted, and to be reduced to a comparatively small rounded or sub-polygonal central tube, which is in turn surrounded by a thickened ring of sclerenchyma, which usually shows distinct traces of its being composed of successively-deposited concentric laminæ. In the latter case there is still a ring of sclerenchyma within the dark outer polygonal boundary; but this ring is of small thickness comparatively, and the central tube is wide and open. Further, in both cases alike there are two phenomena observable which we are at present unable to account for. One of these consists in the fact that the ring of sclerenchyma within the corallite is never in contact with the outer polygonal wall for more than one half or two thirds of its circumference, being separated from the latter throughout the remaining part of the tube by a distinct and conspicuous interspace, which is filled in the fossil with transparent calcite. Not only is this partial interspace between the inner ring and the outer wall apparently always present (fig. 2, A), but it seems to be always situated upon the same side of all the corallites in any particular section. The other inexplicable feature is, that the outer dark walls of the corallites appear to be always in close contact, whereas an examination of the exterior of the tubes shows them to be only in contact along the planes where thickenings of the wall are developed, while they are separated by distinct intervals in the spaces between them.

Moreover, in many parts of tangential sections the corallites exhibit few features that would satisfactorily separate them from similar sections of certain *Monticuliporæ*—though they usually have exceptionally thick walls, and also often exhibit a thin dark ring a little within the true wall and concentric with the latter. There are also some other phenomena occasionally observable which it is extremely difficult to explain; and we must admit that there are various points as to the anatomy of this curious genus which must remain obscure until a large series of specimens can be microscopically investigated.

Longitudinal sections of the corallites (fig. 2, C) show the periodical annular thickenings of the tubes in a very instructive manner, and demonstrate that these are really *thickenings of the wall*, projecting both externally and internally; so that it is not correct to regard the corallites as being "periodically constricted," this phrase applying only to the visceral chamber In fact the longitudinal section of the wall has a regularly moniliform appearance, owing to its successively traversing

thickened and unthickened segments. Sections of this kind also show that there exist remote and complete tabulæ, which are usually placed at approximately corresponding levels in all the corallites of a single colony. Lastly, these sections occasionally show mural pores, though these structures can best be made out by a microscopic examination of the exterior of the tubes, when they are found to have the form of small, circular, irregularly-distributed apertures. It may be added that long sections show the same puzzling feature as do tangential slices—namely, that the corallites are apparently in contact throughout their entire length, whereas macroscopic examination shows them to be clearly free over the unthickened segments of the tube.

Our specimens are not in such a condition as to justify our making any definite statements as to the characters exhibited by the surface, except that the calices are certainly not oblique. The exterior of the mouths, according to Lonsdale, are round or slightly oval, and the dividing ridges sharp, with a large tubercle at the interspace between every four mouths. So far as we can judge, the general aspect of the calices is very similar to that of either *Monticulipora* or *Chætetes*; and we should therefore doubt if a simple inspection of the exterior would enable an observer to certainly separate an example of *Stenopora* from one of either of the latter genera. At any rate, it is probable that the presence of spines or tubercles in the lips of the calices (even if a constant character) cannot be supposed to have more than a mere specific significance.

As to the affinities and systematic position of *Stenopora*, Lonsd., the discovery by Prof. de Koninck of mural pores, and the existence of these in other forms, as demonstrated by us, are quite conclusive as to the propriety of referring the genus to the Favositidæ; and it is thus widely removed from *Chætetes*, Fischer, and *Monticulipora*, D'Orb., to which it bears a striking superficial likeness, and from which it has usually been supposed to be hardly, or not at all, separable. Within the family of the Favositidæ the genus holds an entirely unique position, and possesses no close ally with which it need be compared in detail.

In making specific determinations of *Stenoporæ* we labour under a certain disadvantage; for it has already been pointed out by one of us that the collection containing two of the types (*S. tasmaniensis*, Lonsd., and *S. ovata*, Lonsd.) has been lost; but this is partly counterbalanced by the existence of the fine specimens of the same species described by Mr. Lonsdale in the Strzelecki collection.

Geological Position. So far as can be at present stated, the

species of *Stenopora*, Lonsd., are confined to the Carboniferous or Permo-Carboniferous formation of Australia and Tasmania. There is, indeed, some uncertainty as to the precise geological horizon of some of the deposits which have yielded *Stenopora*; but there is no reason to think that any of these are of Silurian age, and all the corals of this formation which have been at various times referred to *Stenopora* must, pending their complete examination by microscopic methods, be placed under *Chætetes* or *Monticulipora*.

Addendum.—The preceding description of the genus *Stenopora* was founded entirely upon an examination of *S. ovata*, Lonsd., and of the undoubtedly congeneric *S. Jackii*, nobis. Since this was written, however, we have been enabled to examine *S. tasmaniensis*, Lonsd., *S. crinita*, Lonsd.; and a third form, which may be *S. informis*, Lonsd., and we have thereby gained some additional information, and at the same time, in some respects, materially augmented the difficulty which we have experienced in our endeavour to interpret the structure of this extraordinary genus. So many points, indeed, have presented themselves for solution, that we think it best to postpone our remarks upon this subject till we can devote a memoir especially to the elucidation of this genus. In the meanwhile, therefore, we will only say here that *S. tasmaniensis*, Lonsd., is in all its essential details similar to *S. ovata* and *S. Jackii*, whereas *S. crinita* and *S. informis* differ in important respects from the species just mentioned, and show a curious approximation to certain of the so-called *Monticuliporæ*.

Stenopora ovata, Lonsdale.

(Pl. XIV. figs. 1–1 *c*; and woodcut, fig. 2.)

Stenopora ovata, Lonsdale, in Darwin's Geol. Obs. Volc. Islands, p. 163 (1844), and in Strzelecki's Phys. Descr. N. S. Wales, p. 263, pl. viii. figs. 3 *a* & 3 *b* (1845).

Chætetes (?) *ovatus*, Milne-Edwards & Haime, Pol. Foss. des Terr. Pal. p. 273 (1851).

Monticulipora tumida (pars), De Koninck, Nouv. Rech. Terr. Carb. Belgique, p. 143 (1872).

Favosites ovata, De Koninck, Pal. Nouv.-Galles du Sud, pt. iii. p. 156, pl. iii. fig. 5 (1877); Etheridge, jun., Cat. Australian Foss. p. 36 (1878).

Spec. char. Corallum sublobate or submassive, of cylindrical or flattened branches, which have a diameter of from half an inch to an inch and a half or more. Corallites vertical, or nearly so, in the centre of the branches, but finally bending outwards nearly at right angles, and being continued for some distance in this direction before reaching the surface. Coral-

lites in the central portions of the corallum thin-walled, polygonal, and closely contiguous; but in the horizontal portion of their course thickened by annular accretions, by which the tubes are placed in contact, the intervening unthickened segments being free. Corallites on an average from $\frac{1}{70}$ to $\frac{1}{80}$ inch in diameter, tubes of smaller size being here and there intercalated among the larger ones. In the outer portion of the tubes about six of the annular thickenings of the tubes and as many unthickened segments occupy the space of one line. Tabulæ horizontal, complete, remote from one another as a general rule, and, for the most part, placed at corresponding levels in contiguous tubes, these levels having no evident relation to the annular thickenings of the tubes.

Obs. Having already given a full account, so far as our materials permit, of the internal structure of the genus, we need not go into details as to the minute internal structure of the present species. Our specimens, moreover, do not exhibit the surface in any manner that would enable us to give the external characters of the species. That our specimens are referable to *Stenopora* is proved beyond a shadow of doubt by their microscopic structure; and in identifying them with *S. ovata*, Lonsd., we have relied chiefly upon the rapid divergence of the tubes from the central bundle, and the great number and close arrangement of the annular thickenings of the corallites in the horizontal portion of their course, these being sometimes so much developed as to give to the exterior of the tubes a regularly crenulated appearance. The annular thickenings are also unusually broad; and many smaller tubes are interpolated among the larger ones as the surface is approached.

Our determination is the more to be relied on as we have made a direct comparison between Mr. Jack's specimens and Mr. Lonsdale's Strzeleckian type*, although, for reasons previously explained, we have not had the advantage of examining the specimens upon which the species was originally based by Mr. Lonsdale, and which were collected in Tasmania by Dr. Charles Darwin, F.R.S.

Locality and Horizon. Permo-Carboniferous, Coral Creek, Bowen-River Coal-field, Queensland.

Collector. R. L. Jack, Esq., F.R.G.S., F.G.S., &c.

Stenopora Jackii, Nich. & Eth., Jun. (Woodcut, fig. 1.)

Spec. char. Corallum ramose, dividing at wide intervals, the branches cylindrical, averaging about two lines in dia-

* Phys. Descript. N. S. Wales, &c., 1845, t. 8. f. 3 (coll. Brit. Mus.).

meter, and gradually tapering to their free extremities. The corallites are nearly vertical in the axial portion of their course, but ultimately bend outwards nearly at right angles to the imaginary axis of the branches, and open on the surface by rounded calices which are free from any obliquity. As the terminations of the branches are approached the angle of deflection of the corallites becomes less and less, and the horizontal portion becomes shorter and shorter; until at the extremity the whole of the corallites are nearly vertical. Average diameter of the corallites from $\frac{1}{70}$ to $\frac{1}{80}$ inch, smaller tubes being intercalated among those of average size as the surface is approached. Annular thickenings of the horizontal portions of the tubes narrow and ring-like, about five occupying one line, this being the total length, in general, of the annulated portions of the corallites. Mural pores minute, irregularly distributed. Surface not observed.

Obs. This is a graceful and well-marked species, easily distinguished from *S. ovata* and *S. tasmaniensis* of Lonsdale by its habit and general proportions. We should have been inclined to refer it to *Stenopora* (*Chætetes*) *gracilis*, Dana, had it not been for the fact that Dana lays stress upon the length of the tubes in the latter species, as well as upon the remarkable paucity of annulations in the same.

In the present species, on the other hand, the annulations of the tubes in the horizontal portions of their course are much more numerous than in *S. tasmaniensis*, Lonsd., while it differs conspicuously from *S. ovata*, Lonsd., in its size and general proportions. The presence of minute irregularly placed mural pores can be readily made out in specimens which are longitudinally fractured, by an examination of the exterior of the tubes under low powers of the microscope.

Locality and Horizon. Permo-Carboniferous, Coral Creek, Bowen-River Coal-field, N. Queensland.

Collector. R. L. Jack, Esq., F.G.S.

Stenopora? sp.

Obs. Among our specimens from the Daintree collection we have numerous examples of a ramose coral which, from its *general appearance*, can only be regarded as a species of *Stenopora*, but which, so far as we can make out, does not exhibit the peculiar internal structure of this genus as typified by *S. ovata*, and which we, therefore, think may possibly be a *Monticulipora*, D'Orb. The specimens in question occur abundantly in a curious chloritic conglomerate (of Devonian or Carboniferous age?), which is largely impregnated with a grass-green chloritic or serpentinous mineral; and none

of them exhibit the characters of the surface. Moreover, though the coralla are calcareous, and are themselves permeated by crystalline calcite, their more delicate structures seem to have been destroyed during the process of fossilization, and microscopic sections fail to show the internal structure in a thoroughly satisfactory manner.

The corallum in this form is ramose, the branches from two to five lines in diameter, diverging from a main stem obliquely or at right angles, the terminal portions always bifurcating, and the apices of the branches rounded or lobate. The corallites, after a short vertical course in the axis of the branches, are abruptly deflected nearly at right angles; and after holding this latter course for a space of from half a line to a line or more, they open by direct apertures upon the surface. As examined by a lens, the outer horizontal portions of the corallites appear to be thickened at intervals, as in *Stenopora*; but thin sections do not confirm this view of their structure. On the contrary, their walls seem to be uniformly thickened, the thickening increasing in amount as the calices are approached, and sections at right angles to the tubes appear to give clear indications of the existence here and there of a series of interstitial tubuli. Neither tabulæ nor mural pores are recognizable with any certainty.

When fractured surfaces of this coral are examined, the appearance presented is so *Stenopora*-like, that we feel ourselves obliged to refer the species to *Stenopora* rather than to *Monticulipora*, notwithstanding the absence of the more detailed characteristic internal structure of the former genus. It is, of course, just possible that this may be due to the mode of preservation. The general aspect of this species is quite that of Dana's *Stenopora* (*Chætetes*) *gracilis*, especially in the lobate bifurcation of the terminal branches; but the internal structure, so far as known to us, does not altogether correspond with the latter. Our *Stenopora* disagrees with Dana's species in the same way as *S. ovata* does; viz. the periodical thickenings, although faintly marked, are much too numerous for *S. gracilis*.

Locality and Horizon. In a fine conglomerate containing much chloritic matter, Gympie Gold-field. Devonian or Carboniferous (?).

Collector. The late Richard Daintree, Esq., C.M.G., F.G.S. (*Coll.* Brit. Mus.)

Genus Aræopora, Nich. & Eth., Jun., gen. nov.

Gen. char. Corallum massive, resembling that of *Favosites*, of polygonal corallites, which radiate outwards from an ima-

ginary axis to open upon the upper surface of the colony. Under surface covered with an epitheca (?). The corallites are firmly united by their walls, which are extensively pierced by apertures, placing the visceral tubes in direct communication. Septa trabecular, often irregularly divided, or anastomosing at their free ends. Tabulæ rudimentary, represented by occasional horizonal trabeculæ. No columella nor cœnenchyma.

Obs. This genus is founded upon a single remarkable specimen belonging to the "Daintree collection," from the Devonian or Carboniferous deposits of Queensland, which we propose to distinguish specifically by the name of *Arœopora australis*, and of which we subjoin a brief description.

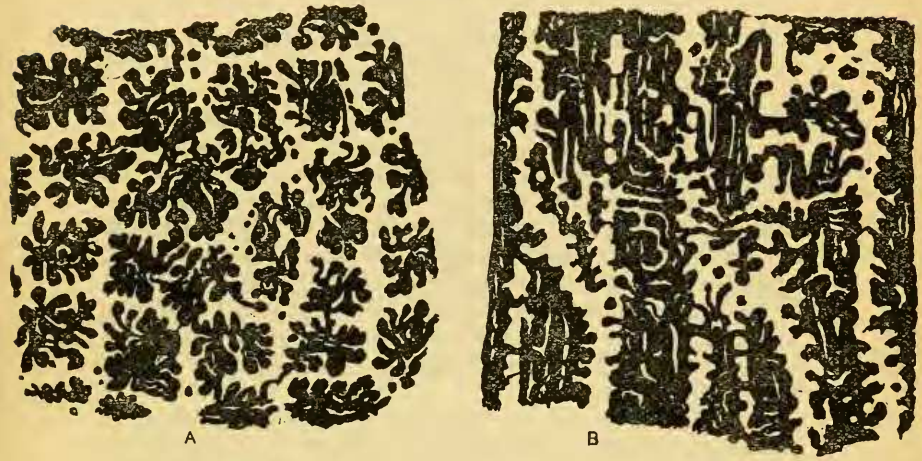
Arœopora australis, Nich. & Eth., Jun.

Spec. char. Corallum massive, pyriform, of considerable size, composed of polygonal or prismatic corallites which radiate outwards from an imaginary axis to open on the upper surface of the colony. Average diameter of the corallites from two thirds to three fourths of a line, no very small tubes being intercalated amongst those of ordinary dimensions. Walls amalgamated, irregularly cribriform. Septa variable in number, spiniform, or irregularly divided. Tabulæ rudimentary.

Obs. The corallum of *A. australis* might at first sight be readily taken for that of any of the larger and more massive species of *Favosites* (such as *F. hemisphæricus*, Yand. & Shum.), though even to the naked eye the absence of distinct tabulæ and the cribriform or porous condition of the walls are striking features. Our only specimen is not perfect, and is not only completely silicified, but is thoroughly infiltrated with silica tinged with oxide of iron. Its height is rather more than three inches, and its greatest width something over four inches. Its form is pyriform, the narrow base having evidently been attached to some foreign body, while the under surface was almost certainly covered by an epitheca, of which no traces now remain. The calices must have opened over the whole of the upper surface; but none of them are preserved in the specimen now before us. The corallites radiate with a graduated divergence from the imaginary axis of the colony; and their form is regularly prismatic or polygonal, as in *Favosites*. This character, however, is much more perceptible by the eye, or when the surface is examined with a lens, than it is when thin sections are investigated under the microscope, as it is to some extent masked in the latter case by the broken and cribriform structure of the walls. Thin sections (fig. 3, A & B), whether transverse or vertical, show that the walls of

the tubes are extensively porous and cribriform, being pierced by numerous apertures, which place the visceral chambers in direct communication. Transverse sections also serve admirably to show the character of the irregular trabecular septa, some of which are simply spiniform, while others divide towards their inner extremities, or even unite with their neighbours by their free ends. Vertical sections show that the septa are, upon the whole, placed in longitudinal rows; and they exhibit occasionally horizontal trabeculæ (fig. 3, B), which may be regarded as of the nature of rudimentary tabulæ.

Fig. 3.



A. Part of a transverse section of *Arœopora australis*, Nich. & Eth., Jun., enlarged eight times, showing the trabecular septa and porous walls. B. Part of a vertical section of the same, similarly enlarged, showing the cribriform character of the walls, the septa, and the rudimentary tabulæ. Devonian, Queensland (Daintree collection).

From a consideration of the above characters it cannot be doubted that we have to deal in *Arœopora* with a genuine "Perforate" Coral, which, however, is closely related to the Favositidæ, and may be best placed in this family rather than in any of the more regular groups of the Perforata. By the characters of its walls and septa the genus presents certain alliances with the Poritidæ; but its general form and aspect are those of a *Favosites*; and the presence of rudimentary tabulæ would further confirm the view here taken. Among the genera of the Favositidæ its nearest ally is to be found in

the Lower Silurian genus *Columnopora*, Nich., which it nearly resembles in form and habit. It is distinguished from the latter, however, by the less regularly perforate character of its walls, by the rudimentary condition of its tabulæ, and by the irregularly dividing and trabecular septa. We are unable to institute any comparison between *Arœopora* and the Cretaceous genus *Koninckia*, E. & H.; but the septa of the latter seem to be merely spiniform (six in number), and the tabulæ are said to be well developed and complete.

Locality and Horizon. Limestone of the Burdekin River, N. Queensland. Devonian.

Collector. The late R. Daintree, Esq.

Genus Pachypora, Lindström.

Pachypora meridionalis, Nich. & Eth., Jun.

Spec. char. Corallum ramose, of cylindrical branches, about two lines and a half or three lines in diameter, dividing dichotomously at comparatively remote intervals. Corallites not regularly polygonal, with very thick walls, the diameter of which increases as the mouth is approached. Calices hardly at all oblique, about a third of a line, or sometimes rather more, in diameter, oval, rounded, or irregular in shape, often opening into one another, surrounded by thick obtuse margins, which exhibit no traces of the original polygonal wall of the corallite. Mural pores few, very large, and irregularly placed. Tabulæ few and remote.

Obs. This species is unquestionably very closely allied to *Pachypora* (*Favosites*) *cervicornis*, De Blainv., of the European Devonian; and we have felt some hesitation in giving it a distinct specific designation. Both belong to that section of *Favosites* in which the walls are thickened by the secondary deposition of sclerenchyma in successive laminæ, the amount of this thickening being increased as the mouth is approached; and both are therefore referable to Lindström's genus *Pachypora*. Both are alike in form and general habit, and have singularly large, sparse, and irregular mural pores. After a comparison, however, of the Australian specimens with examples from the Eifel, both macroscopically and microscopically, we have come to the conclusion that the former must in the meanwhile be regarded as specifically distinct, upon the following grounds:—

a. *Pachypora meridionalis*, nobis, is, on the whole, a much smaller species than *P. cervicornis*, De Blainv., the branches in the latter often reaching 8 or 10 lines in diameter.

b. The corallites in *P. cervicornis* can always be shown, by

thin sections, to preserve their polygonal outline, in spite of the thickening to which they are subjected; in the axis of the branches they are regularly polygonal; and even the thickened lips of the calices show more or less distinctly a polygonal line placed at a little distance from the mouth of the tube, which represents the original wall. On the other hand, in *P. meridionalis* the polygonal form of the corallites is more or less completely obliterated, even in the axis of the branches the originally prismatic wall cannot be detected, and the thickened lips of the calices are simply rounded and obtuse.

c. In *P. cervicornis* the calices are about half a line in diameter, rounded or subpolygonal, and only occasionally opening into one another. In *P. meridionalis*, on the contrary, the calices are mostly only about a third of a line in diameter (counting in, as before, the wall around them), their shape is very irregular, and they open into one another so frequently, and to such an extent, that they sometimes become almost vermiculate in character.

Upon the whole, therefore, we consider the present species to be sufficiently distinct from *P. cervicornis*, De Blainv., to deserve a separate name; and we know of no other adequately characterized species with which it is necessary to compare it in detail. We may add that the differences between *P. meridionalis* and *P. cervicornis*, which we have above alluded to, are much more conspicuous if we take specimens of the form usually known by the latter name in the Devonian Limestones of Devonshire, and figured as such by Milne-Edwards and Haime (Brit. Foss. Cor. pl. xlviii. fig. 2).

Locality and Horizon. In Devonian Limestone (apparently abundant), Fanning River, Burdekin, N. Queensland; Limestone of Arthur's Creek, Burdekin Downs, N. Queensland.

Collector. R. L. Jack, Esq., F.G.S.

Pachypora? sp. ind.

Obs. A second and ramose form, in all probability referable to this genus, occurs in the Fanning-River Limestone; but the state of preservation did not permit of our making thin sections; so that we can do no more than simply record the occurrence of it. The same form is also met with at Reid.

Collector. R. L. Jack, Esq.

Genus Trachypora, Edw. & Haime, 1851.

(Polyp. Foss. Terr. Pal. p. 305.)

Trachypora, sp. ind.

Obs. So far as we are aware, *Trachypora* has not been

hitherto recognized as an Australian genus of Palæozoic Corals. Mr. Jack has forwarded to us a single and badly preserved example, which, although sufficiently good for generic identification, is in too ill-preserved a condition to warrant us in attaching to it a specific description and name.

The specimen is seated on the weathered surface of a piece of limestone, and exhibits the vermiculate surface and non-septate calices characteristic of *Trachypora*.

Horizon and Locality. Arthur's Creek, Burdekin Downs, N. Queensland. Devonian Limestone.

Collector. R. L. Jack, Esq.

Genus Aulopora, Goldfuss, 1826.

(Petrefacta Germaniæ, i. p. 82.)

Obs. Without at present entering into the question of the extent to which *Aulopora*, *Syringopora*, and *Cladochonus* may be regarded as distinct, it may be simply stated that only one species of *Aulopora* has been described from the Palæozoic rocks of Australia, viz. *Aulopora fasciculata*, De Koninck*, from the Upper Silurian of Bell River, New South Wales. We have now to place on record the presence, in the Arthur's Creek Limestone, of a form possessing all the characters of the European Devonian *Aulopora repens*.

Aulopora repens (Knorr & Walch.), Edwards & Haime.

Aulopora serpens, Goldfuss, Pet. Germ. i. p. 82, t. 29, f. 1.
Aulopora repens, Edwards & Haime, Pol. foss. Ter. Pal. 1851, p. 312.

Obs. We have an example of this interesting coral creeping over the surface of a specimen of *Heliolites porosus*. The weathering of the surface of the coral has removed the epitheca and exposed wall of the *Aulopora*, and laid bare the interiors of the ramifying or stolon-like corallites.

The spaces enclosed by the union of the corallites are irregular in shape, some polygonal, others elongated. The corallites either occur along the course of the creeping network, or are thrown off as a small projection at each bifurcation. There is no regularity in their disposition: at one point they succeed one another very rapidly along the creeping tubes, and are much crowded; but on other portions they are scattered and separated by much greater interspaces. On the edge of the corallum, where the reticulation becomes of a more open nature, the zigzag appearance given to the corallites by frequent dichotomization becomes very apparent. There are no septa visible in our example.

* Foss. pal. Nouv.-Galles du Sud, 1876, p. 14, t. 1. f. 1.

Horizon and Locality. Arthur's Creek, Burdekin Downs, North Queensland. Devonian Limestone.
Collector. R. L. Jack, Esq.

In addition to the corals which we have now described, the Arthur's-Creek Limestone has yielded a colony of *Lithostrotion* or *Lonsdaleia*, enveloped in a mass of *Stromatopora*, and partly silicified. In all probability it is a species of the former genus.

5. *Distribution of the Species and Age of the Beds.*

1. The fossiliferous beds of Coral Creek, at a point below the Sonoma road-crossing, in the Bowen-River Coal-field, have yielded

Stenopora ovata, *Lonsdale.*
—— Jackii, *nobis.*

2. The Fanning-River Limestone has also afforded the following two species, although there are indications of other corals not determinable :—

Heliolites porosus, *Goldfuss.*
Pachypora meridionalis, *nobis.*

3. The green fossiliferous chloritic rock of the Gympie gold-field is crowded with a pretty coral, which may be a *Monticulipora*, but which we place provisionally as

Stenopora ? sp. ind.

4. The limestone of the Broken River, a tributary of the Burdekin River, contains :—

Favosites gothlandicus (*Fougt*), *Lamk.*, vars.
Heliolites porosus, *Goldfuss.*
—— plasmoporoides, *nobis.*
—— Daintreei, *nobis.*
——, sp. ind.
Aræopora australis, *nobis.*

5. The Arthur's-Creek Limestone, Burdekin Downs, has yielded the largest number of species, viz. :—

Caunopora.
Stromatopora.
Alveolites (Pachypora), sp. near A. robustus, *Röm.*
—— (lobate form), sp.
Aulopora repens, *Ed. & H.*
Heliolites porosus, *Goldfuss.*
—— ——, vars.
Lithostrotion, sp. ind.
Pachypora meridionalis, *nobis.*
Trachypora, sp. ind.

With regard to the first locality, we would simply point out here that evidence has been elsewhere adduced by one of us to show that in all probability certain of the beds of the Bowen-River Coal-field, including those of Coral Creek, are of Permo-Carboniferous age, with a strong leaning towards the Permian aspect—and that the detailed examination of the *Stenoporæ* in no way invalidates this view, but, on the contrary, lends colour to it.

The Gympie series, from which the coral we have noticed as *Stenopora*? (or perhaps *Monticulipora*) is derived, is considered by Mr. R. Etheridge, F.R.S., to be of Devonian age. We are not in a position either to confirm or disprove this opinion, as the material examined by us throws no fresh light upon the subject.

The Fanning-River Limestone and its associated shale have been shown, in the paper just referred to (as before the Geological Society), to possess a strong claim to be considered Devonian. We have determined only two corals satisfactorily from this horizon, *Heliolites porosus* and *Pachypora meridionalis* (nobis). The former, a typical Devonian coral in Devonshire and the Eifel, supports the evidence afforded by the Mollusca in a marked degree; that of the *Pachypora* will be considered immediately.

We now come to the two last localities, both in the Burdekin district—a limestone developed on the Broken River and Arthur's Creek, Burdekin Downs. The first point to be noticed in connexion with these localities is the presence of massive *Favosites*, of the Devonian type, quite undistinguishable from the *F. gothlandicus* and its variety *F. Goldfussi*, of the Devonian of Europe and North America. Secondly, we note the presence of numerous large colonies of *Heliolites*, including *Heliolites porosus* in abundance.

Again, strong evidence of a Devonian age is afforded by the appearance here of a coral which we cannot distinguish from *Aulopora repens*, Edw. & H., a very characteristic Devonian species, and of the equally characteristic Devonian genus *Trachypora*, while species of *Alveolites* of a Devonian type are also present. Hardly less characteristic is the *Pachypora* to which we have given the name of *P. meridionalis*, and which is most intimately allied to the *P. cervicornis*, De Blainv. sp., of the Devonian of Europe, and to similar or identical forms in the Devonian of North America. Upon the whole, therefore, putting to the evidence afforded by the corals that derived from such characteristic forms as *Stromatopora* and *Caunopora*, we cannot doubt that the deposits now under consideration are of Devonian age. So

far as we are acquainted with their fauna, they would seem to correspond very closely with the Middle Devonian Limestones of the Eifel, or perhaps with the somewhat older series of the Corniferous Limestone of North America; but we do not doubt that large additions will yet be made to the list of fossils from these beds, when it will be possible to compare them more closely with the corresponding deposits in Europe and North America.

In conclusion, we may at once state that our investigations amongst the corals of the Broken-River and Arthur's-Creek Limestones of North Queensland quite enable us to confirm, in a general way, Mr. Etheridge's opinion of the former series, that "their age is undoubtedly Lower Devonian or 'Siluro-Devonian.'"

EXPLANATION OF PLATE XIV.

Fig. 1. A fragment of *Stenopora ovata*, Lonsd., of the natural size. 1 *a*. Side view of three corallites of the same, in the outer portion of their course, enlarged, showing the periodic thickenings of the tubes. 1 *b*. Part of a tangential section of the same, taken just below the surface, and enlarged twenty-five times, showing the hexagonal corallites and the ring-like deposit of sclerenchyma in the interior of many of the tubes. 1 *c*. Part of a vertical section of the same, enlarged twenty-five times, showing the periodical thickenings of the tubes, the remote tabulæ, placed at corresponding levels in contiguous tubes, and the mural pores. 1 *d*. Part of a transverse section of *Stenopora crinita*, Lonsd., enlarged ten times, showing the ring-like sclerenchymatous deposit in the tubes, introduced for comparison with 1 *b*.

Fig. 2. A small portion of a transverse section of *Heliolites plasmoporoides*, nobis, of the natural size. 2 *a*. Part of the same section, enlarged five times. 2 *b*. Part of a vertical section of the same, enlarged five times, showing that the tabulæ of the smaller tubes have the characters of those of *Heliolites* and not of those of *Plasmopora*.

Fig. 3. Part of the surface of *Heliolites Daintreei*, nobis, of the natural size, showing the proportions and relative positions of the large corallites. 3 *a*. Part of a transverse section of the same, enlarged five times.

Fig. 4. A small fragment of *Pachypora meridionalis*, nobis, of the natural size. 4 *a*. Portion of the surface of the same, enlarged five times. 4 *b*. Tangential section of the same, enlarged ten times, showing the thickened walls of the corallites. 4 *c*. Part of a longitudinal section of the same, enlarged ten times, showing the thickening of the tubes near their mouths. In the portion of the section represented, the visceral chambers of the corallites are filled with matrix, rendering it impossible to recognize the tabulæ or mural pores.